

Finding of the LWS Science Architecture Team
July 2001 meeting

#1: Geospace Mission Definition Team to include Modelers

The objectives and goals of LWS call for a close and integrated connection between experiments, modeling, and theory leading to breakthroughs in our understanding of the space science that has societal impacts. For this to happen, modeling must play a key component at the initiation of the mission definition process. Experts in geospace modeling should be included on the mission definition team to ensure two outcomes:

(1) to assure that the appropriate measurements are made to advance and validate the models, and

(2) to assure that modelers meet their obligation of making testable predictions for the LWS community.

In addition, a solar/heliospheric expert should be included in the team to ensure overlap and coordination with solar/heliospheric inputs into geospace.

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#2: Theory, Modeling and Data Analysis Program Management

The Living With a Star program will be considered a success if and only if there are substantial improvements in theoretical understanding and modeling of each component of the Sun-heliosphere-geospace system, and in particular of the linkages among these components. Theory and modeling is the embodiment of knowledge acquired by the LWS program. It is a product and an output -- a deliverable that will provide lasting benefits and permit the eventual transition to an operational program. Data analysis will provide one of the key means by which improvements in theory and modeling will occur.

It would be unwise to assume that the required theory, modeling and data analysis program will arise by chance -- generated only by the natural instincts of the community. Rather it must be pro-actively orchestrated. Components must be developed in concert. Observations must feed improvements in the models. Models must be seamlessly linked and new ideas and new concepts injected so that the final product is a working end-to-end model or models accurately depicting the comprehensive knowledge generated by the Living With a Star program.

The SAT believes strongly that a comprehensive theory, modeling and data analysis program needs to be embarked upon immediately. To that end:

1) A Theory, Modeling & Data Analysis Definition Team (TMDADT) needs to be formed, with the same status as Mission Definition Team (MDTs), for the purpose of designing a coordinated and comprehensive theory, modeling and data analysis program. The TMDADT's charge should include:

- (a) a definition of goals and objectives of the programs --
i.e. definitions of the metrics against which a successful LWS theory, modeling and data analysis program will be measured,
- (b) recommendations on the management structure that will be in place throughout the LWS program, and that will ensure coordinated and unified development of theory, modeling and data analysis across the LWS system.
- (c) recommendations on procedures to ensure that the program encourages and promotes new concepts and understanding, and provides for their speedy inclusion in the developing models,
- (d) a preliminary assessment of the data that will be needed for success with the development of theories and models that can provide useful guidance to the MDTs, and

- (e) an assessment of the utility of and necessity of data for theory and model development that can be provided from existing and planned NASA and non-NASA sources.
- 2) Selected members of the TMDADT should also be appointed to the MDTs to ensure coordination. The converse should also occur: members of the MDTs should have joint appointments with the TMDADT.
- 3) The TMDADT should disband and be replaced by the permanent management structure that will ensure success of the theory, modeling and data analysis effort.

The LWS program has accepted a daunting challenge -- to deliver comprehensive knowledge and improved predictability of how our changing Sun impacts our society. There are multiple spacecraft, coordinated measurements, and intertwining theories and models. The challenge is one of science and also one of management, and nowhere is the success in meeting the management challenge more crucial for the ultimate success of LWS than it is for theory, modeling and data analysis.

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#3: Comprehensive Data System Management

The LWS program goal is to develop the scientific understanding necessary to effectively address those aspects of the connected Sun-Earth system that directly affect life and society. In order to build the required comprehensive observational picture, the LWS program needs to create a data system from which researchers can easily access the multiple observations required to develop, refine, and test theory and modeling of the Sun-Earth system.

The SAT strongly believes that a Data Systems Team should be formed to examine these issues and make specific recommendations to LWS management. Issues to be examined by the DST include

- identification of NASA and non-NASA spacecraft and ground observations that play important, or critical, roles in acquiring the data required to carry out the theory and modeling advances required to achieve the goals of LWS, including mission extension and scientific productivity of existing NASA assets. This assessment might be carried out by the DST in coordination with the TMDADT.
- partnering or other arrangements with non-NASA agencies to help ensure the availability of observations from non-NASA missions that are important or critical to LWS
- creation a system from which individual researchers can easily access the multiple observations required to develop, refine, and test theory and modeling of the Sun-Earth system. This effort could build on existing archives such as those from the ISTP program, or might be a distributed, virtual system.
- Examination of the costs of the data system, and in particular the benefits of adding a particular data set(s) to the system compared with the associated cost.

The SAT points out that in the multi-year period before the first LWS mission is launched, many important LWS problems could be addressed using this system, thus yielding payback from the LWS investments early in the program. Such investigations could include not only topics addressed by current observations, but perhaps more importantly, topics that require investigation of solar-cycle dependences. Improved models of the radiation belts is an obvious example.

It is essential that LWS management and its Data Systems Team initiate this effort in the near future, so that the required system will formed early in the LWS program.